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Fall 2015

ENME 4097

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University of New Orleans

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Special Topics in Mechanical Engineering – Friction Stir Welding
ENME 4097-791
Fall 2015

INSTRUCTOR

Mechanical Engineering 4097 is taught by Dr. Michael Eller

Additional information:

Class Location: Classroom 2, South Mezzanine Training Center, Building 103, NASA Michoud
Assembly Facility, New Orleans
Class Schedule: Fridays 1:30 – 4:30 PM (see detailed course schedule on last page)
Office Hours: Friday 12:00 – 1:00 PM

E-mail: meller@uno.edu

COURSE OBJECTIVES

Course Description: This course is intended to develop a deeper understanding of the principles of mechanical engineering and materials science through investigation of the technology known as friction stir welding (FSW). Since FSW can be classified as a joining process, forming process, forging process, extrusion process, and heat treatment process (among other things), it is an ideal technology for understanding essential engineering processes and systems. The course is designed to include a lecture session and a laboratory session to enhance student's familiarity with the process. Laboratory session will include hands-on training with FSW equipment and actual welding of metallic parts and corresponding joint configurations that are of interest to the aerospace community. Students will be assigned to project teams and will complete a unique FSW investigation pertaining to a particular alloy combination, part configuration/orientation, and/or set of process parameters. The welded parts will be assessed in one or more forms (i.e. mechanical testing, microstructural evaluation, etc.). Teams will be responsible for completing a written paper and oral presentation discussing their results.

Primary Learning Objectives:

1. Reinforce principles of mechanical engineering and materials science by teaching the fundamentals of friction stir welding (FSW)
2. Enhance understanding of engineering materials selection by learning about industry applications of FSW
3. Facilitate team-based FSW projects at the NASA Michoud Assembly Facility using National Center for Advanced Manufacturing (NCAM) machines and tools
4. Emphasize design for manufacturability when planning FSW projects and associated pre-FSW and post-FSW machining activities
5. Teach methods for analyzing results of FSW projects through metallurgical and mechanical testing

COURSE REQUIREMENTS

Prerequisite:

ENME 4097-791 is open to all engineering majors, junior standing or higher; co-listed as 5096-791 for graduate engineering students. All students must be a U.S. Citizen with proof of citizenship; requirement for non-escort security clearance at NASA-Michoud.

Exams and Grading:

Attainment of objectives is assessed by quizzes, mid-term exam, project written report, and project oral presentation.

(Quizzes: 5%) A total of 2 quizzes will be given during the course of the semester. The quizzes are strategically scheduled after the first 2 “Friday offs” to ensure that students are reviewing the assigned reading material. The quizzes are each comprised of no less than 5 questions and the combination of both quizzes will count for 5% of your total grade.

(Exams: 50%) A midterm exam will be given that covers all the lecture material on the topic of FSW. Questions will measure students’ understanding of friction stir welding through principles of mechanical engineering and materials science. Exam will be taken in class on the date specified in the syllabus.

(Project Written Report: 25%) The third deliverable for the course is a written report based on the group project. Student teams will be responsible for FSW a specific configuration of material and interpreting the results. Reports will include both quantitative and qualitative data analysis. Preliminary work (proposing a topic and getting feedback on preliminary analysis) may be included in homework assignments. Students will work on the project in small groups of three to four students depending on the size of the class. Project written reports will be graded on attainment of project goals, completeness of results, proper interpretation of data, and use of engineering / materials science principles.

(Project Oral Presentation: 20%) The fourth deliverable for the course is an oral presentation based on the group project. Student teams will be responsible for organizing their processes and results into presentation format to be presented in front of a professional audience (i.e. engineering professionals from Lockheed Martin, Boeing, Jacobs Engineering, Vivace, Dynetics, and/or NASA). Presentation format and oral delivery of presentations will be graded on the team’s professionalism and ability to convey their project results accurately.

Midterm Exam	50%
Project Written Report	25%
Project Oral Presentation	20 %
Quizzes	5%
TOTAL	100%

A = 90%-100%; B = 80%-89%; C = 70%-79%; D = 60%-69%; F = 0-59%

Incomplete: It is my policy to grant the incomplete grade only in cases of illness, accident, or change in work hours during the last weeks of classes. The attending physician or employer must verify the extreme emergency in writing.

Attendance Policy: Attendance will not be recorded for this course, but students missing class when quizzes and exams are given will not have the opportunity for make-up the exam or quiz unless the circumstances below are met. Availability for oral presentation will be collected early on in the course to avoid any student conflicts. All students must attend and present at the oral presentation or forfeit their oral presentation grade.

Make-up Exams/Quizzes: Make-up exams and quizzes will only be given for extraordinary circumstances. These circumstances are defined as events for which the student does not know about prior to the exam date, and over which the student has no control. **Examples are death in the family; acts of God, such as hurricanes, flooding, or other related weather events; hospitalization of the student or immediate family member, or dire illness of the student.** If any of these events should occur, it is the students' responsibility to inform the instructor as soon as it happens; a determination will be made at that point as to the possibility of providing a make-up.

Student Conduct: It is important that students conduct themselves responsibly while attending class inside the Michoud Assembly Facility campus including abiding by the government rules for non-escort badge holders (to be explained in further detail by the instructor). Students must wear long pants and closed toe / closed heel shoes for all classes since we will spend time in the laboratory for every meeting with exception of the final oral presentations.

COURSE TEXTBOOKS (OPTIONAL)

1. Mishra, Rajiv S.; De, Partha Sarathi; Mahoney, Murray W., *Friction Stir Welding and Processing: Science and Engineering*, Springer, 2014. ISBN: 3319070436
2. Mishra, Rajiv S.; Mahoney, Murray W., *Friction Stir Welding and Processing*, ASM International, 2007. ISBN: 1615030972

ACADEMIC INTEGRITY

Academic integrity is fundamental to the process of learning and evaluating academic performance. Academic dishonesty will not be tolerated. Academic dishonesty includes, but is not limited to, the following: cheating, plagiarism, tampering with academic records and examinations, falsifying identity, and being an accessory to acts of academic dishonesty. Refer to the Student Code of Conduct for further information. The Code is available online at <http://www.studentaffairs.uno.edu>.

STUDENTS WITH DISABILITIES

It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities should contact the Office of Disability Services as well as their instructors to discuss their individual needs for accommodations. For more information, please go to <http://www.ods.uno.edu>.

COMMUNICATIONS POLICY

E-mail

Instructors will use UNO, LSU, and other college email addresses for communicating with the class. Please watch for occasional e-mails about the course since it is being held at a NASA facility (i.e. non-University owned location) and the instructor may have to send out updated accessibility instructions because of the sensitive nature of this facility.

Preparing for Lectures:

Lectures will be distributed to students ahead of the lecture date. Students should study new material prior to the lectures.

Class Schedule

The course will be held every 2 Fridays during the Fall term with every 3rd Friday off (see detailed course schedule on the next page). Each class will run the full 3 hours with 11 sessions scheduled for the term. The 12th session will be reserved for the oral presentations where students must be available to present aspects of their project. Students with exam conflicts may leave early and/or arrive late if necessary. **If for some reason the schedule must be altered, the instructor will send an email to the class indicating the change.**

COURSE SCHEDULE

Week	Classroom Lecture (~1 hour)	FSW Laboratory (~2 hours)
August 21	Introduction to FSW / NCAM / NASA-Michoud	Demonstration on FSW machines / Plant Tour / Safety
August 28	Application of FSW	FSW Machine Introductory Training
September 4	Labor Day Weekend (no class)	(Students to Review Introductory Material)
September 11	Metallurgical Properties of FSW Quiz #1	Metallography & Machine Shop Equipment Training
September 18	Mechanical Properties of FSW	FSW Machine Programming & Setup Instruction
September 25	3 rd Session Off (no class)	(Students to Review Machine Programming & Setup)
October 2	Design for FSW Quiz #2	FSW Trials & Macrograph Preparation
October 9	Mid-Term Examination	Project Assignment, Team Formation, Develop Weld Plan
October 16	UNO Mid-Semester Break (no class)	(Teams Complete Program Comments, Tooling Storyboard)
October 23	Weld Testing Methodology	Set up Tooling, Prep Panels, Perform Initial FSWs
October 30	Analysis of FSW Data	Perform Remaining FSWs, Rough-Cut Tensile and Macro Specimens
November 6	3 rd Session Off (no class)	(Teams Configure Weld Data, Compile Visual Observations)
November 13	Interpretation of FSW Test Results	Machine Tensiles, Mark, and Send to Test
November 20	Exam Review, Technical Report Overview, Data Analysis	Evaluation of Macro Photos, Tensile Results
November 27	Thanksgiving Break (no class)	
December 4	Final Written Reports Due	Presentation Overview and Presentation Methods
December 11	Final Exam Week - Final Presentations Due	Team Presentations to LM / Boeing / NASA Audience